PB83-246140

Development of a User Charge and Cost Monitoring System for Wastewater Collection and Treatment: A Case Study

(U.S.) Municipal Environmental Research Lab.
Cincinnati, OH

Aug 83

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16. ABSTRACT

Since 1956 the Federal government has committed over 35 billion dollars to improve the capabilities of the Nation's municipal treatment facilities. Traditionally EPA has paid 75% of the capital cost of these facilities. In the future the amount of cost sharing for wastewater facilities is likely to decrease, thereby requiring municipal sources to increase their cost sharing responsibility. Such a change in funding will no doubt force more and more municipal wastewater departments to develop a "utility" approach to financing sewerage activities. This report describes a cost analysis system designed to provide the basic data for a utility approach leading to financial self-support for municipal wastewater activities.

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DEVELOPMENT OF A USER CHARGE AND COST MONITORING SYSTEM FOR WASTEWATER COLLECTION AND TREATMENT: A CASE STUDY

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DEVELOPMENT OF A USER CHARGE AND COST MONITORING SYSTEM FOR WASTEWATER COLLECTION AND TREATMENT: A CASE STUDY

by

Robert M. Clark[1] and James I. Gillean[2]

INTRODUCTION

Since 1956 the Federal government has committed over 35 billion dollars to improve the capabilities of the Nation's municipal wastewater treatment facilities. This is a substantial investment for our society and is particularly significant at a time when there is growing concern over the availability of resources. Despite this investment current unmet wastewater treatment and interceptor sewer needs for existing sewered populations are estimated as $35.4 billion.[1]

Traditionally EPA has paid for 75% of the capital cost of these facilities, but is now caught between the desire to enhance wastewater management by making pollution abatement more effective and severely constrained resources. In an attempt to deal with this dilemma EPA submitted, and in December 1981 the Congress enacted, Public Law 97-117, which contained a number of statutory reforms.[2] Among these amendments to the Clean Water Act are provisions that increased municipal cost sharing from 25 to 45% for construction grants after 1984; that reduced the eligibility of Federal funds to pay for treatment plants, interceptors, infiltration control, and some limited collection system construction; and that placed increased

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emphasis on cost effectiveness. The EPA Construction Grants Program has developed a number of management and program goals in an attempt to achieve these important objectives.[3]

A major goal is that of increased cost effectiveness for current and future waste water facilities. In order to enhance cost-effectiveness the following specific objectives were established:[4] to insure that treatment facility users pay for treatment services in proportion to their use as an incentive for them to reduce their waste discharges and to insure that municipalities have self-sufficient financial management systems to support municipal facility construction and operation. Self-sustained financing and management goals must be achieved with the ultimate objective of achieving the protection of the public health and the environment, including surface and ground water, air, and land. A key element of cost-effective management of wastewater systems is the development of direct user charge and cost-monitoring techniques. These cost monitoring systems can be used to provide the basis of self-sufficiency for the Nation's wastewater treatment and collection facilities.

This paper will deal with the development and application of such a cost analysis system in the Tampa, Florida city sewer department.[5] System development concepts are based on experiences gained from water supply utilities, which have traditionally existed using direct user charge support. It has several unique features that make it different from traditional accounting procedures for water supply.

Traditionally, accounting for water supply is based on "responsibility accounting" principles. The system discussed in this paper extends this responsibility accounting concept to "product costing".[6] Also discussed is the use of the system for continuous cost monitoring.

SYSTEM DEVELOPMENT

Accounting data and the proper development of accounting systems are critical to the management of wastewater utilities. Often there is a conflict between accountants and engineers when the issue of data use is raised. Accounting data tends to be collected according to traditional accounting principals which may not be useful to the manager. Yet the engineer/manager badly needs this information in order to properly operate and manage the utility. In the system discussed traditional accounting data is formatted in such a way that traditional accounting principals are satisfied and the needs of the engineer/manager as well. This system provides an extra dimension by providing spatial identification of the various components of the water supply system. The developmental concept will be discussed in the following section.

COST ANALYSIS CONCEPT

The wastewater cost analysis system is based on a concept developed and implemented in the water supply field. The original system was developed and applied in the Kenton County water utility in Kenton County, Kentucky.[6]

Figure 1 shows a simplifed schematic describing water utility functions divided into acquisition, treatment, delivery, and support services.[7] It is possible to categorize these major functions into subfunctions. For example, delivery could include pumps, storage tanks, transmission and distribution.

Although the details of each function might differ for different water utilites the general concept is the same. For example, acquisition might consist of wells or direct intake from a river but the function must be

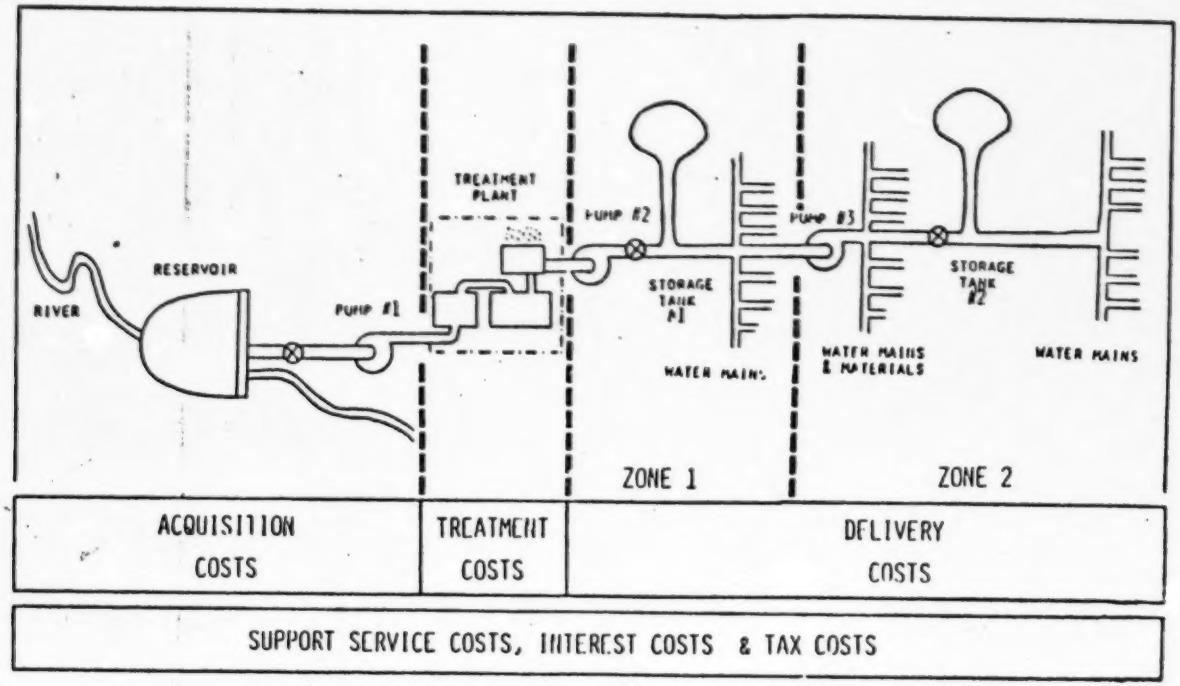


Figure 1. Water utility simplified schematic.

provided. Support services, interest and taxes are assumed to be applied equally to all units of water passing through the system. In order to relate the functions of the utility to traditional accounting categories, a matrix concept is introduced in which the utility functions, and sub-functions and the financial data are related to such costs as labor, power, etc, as might be typically seen in a chart of accounts. Figure 2 illustrates this concept. Across the top of the maxtix are the various service and management functions of the utility. These functions can be subdivided as finely as desired. Down the side of the matrix are the various cost categories. These cost categories can be those that are routinely associated with the utilities standard chart of accounts. As will be discussed later four report levels were established for use by the manager based on this input information.

Figure 3 shows a map of the Kenton County Water District with the major facilities and the pressure zones identified. Water supply distribution and waste water collection systems have a spatial dimension in that they provide service over diverse geographic areas as illustrated by the figure. These service facilities plus any management functions of interest provide the basis for the horizontal elements in the cost matrix.

Figures 4, 5, 6, and 7 are computer listings from the Kenton County cost analysis system relating the physical facilities and management cost centers to the chart of accounts for the utility. Each report contains different levels of detail and information for water utility managers.

The Level IV report is a reproduction of the matrix shown in Figure 2. It is nothing more then a one-to-one allocation of the chart of accounts information to the cost centers. The Level III report aggregates the data from Level IV into data reported by major functional classification such as

	WATER UTILITY FUNCTION			
COST CATEGORY	AQUISITION	TREATMENT	DELIVERY	SUPPORT SERVICES
LABOR				
POWER				
CHEMICALS				
MATERIALS				
MISCELLANEOUS				

Figure 2. Function and cost category information

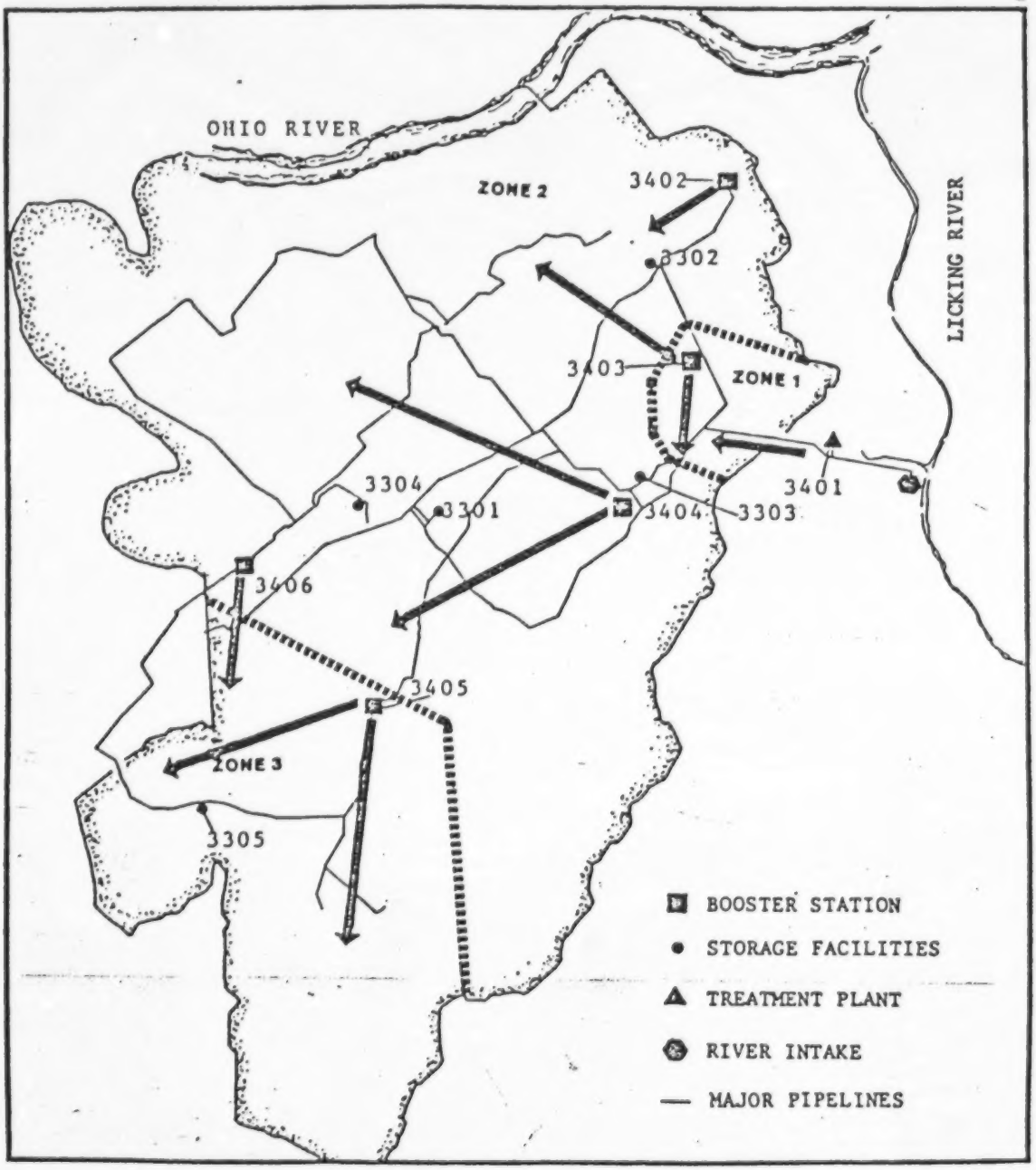
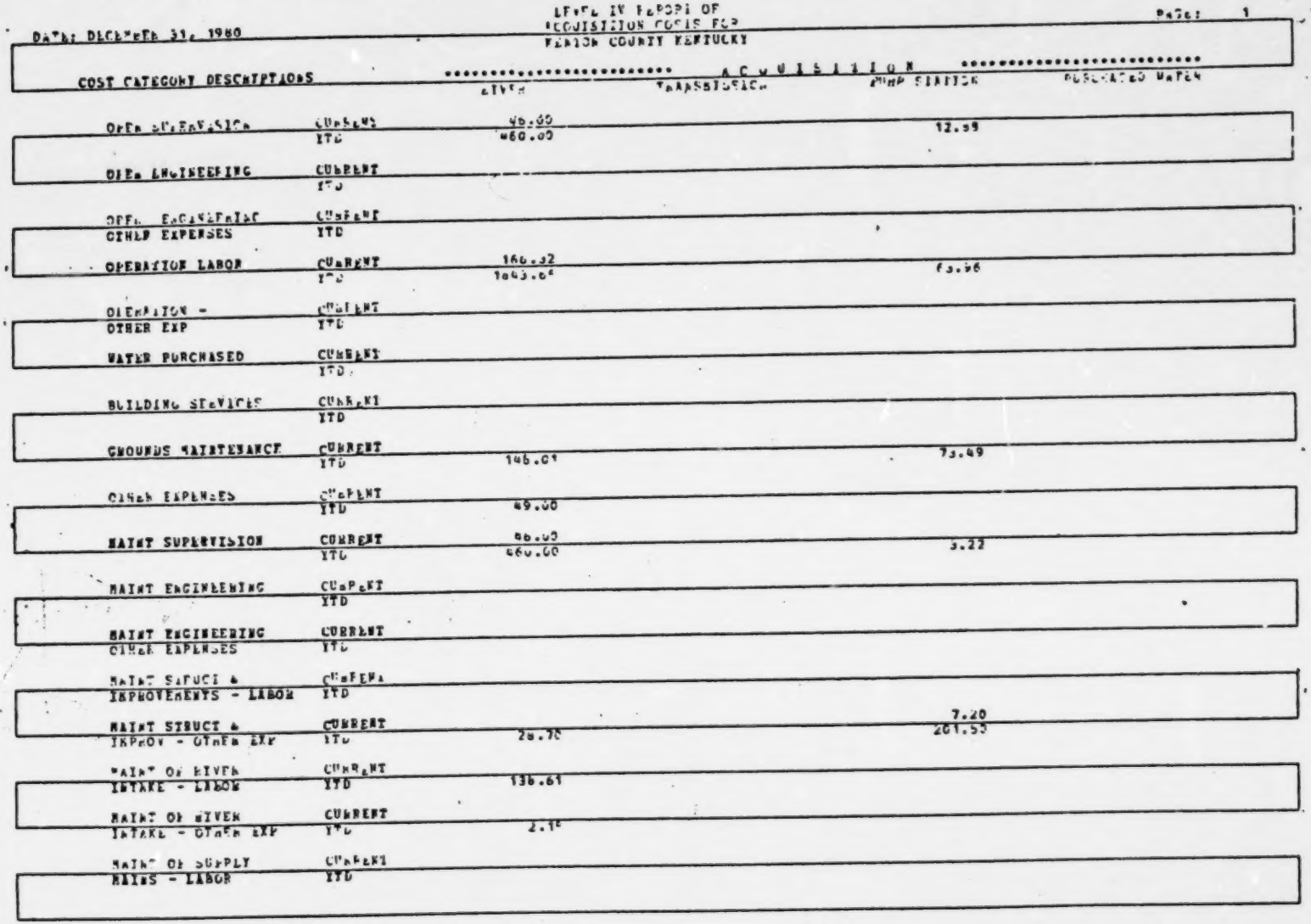


Figure 3. Kenton County Water District No. 1 service area.



LEVEL IV REPORT OF
ACQUISITION COSTS FOR
PERRY COUNTY KENTUCKY

Date: DECEMBER 31, 1980 Page: 1

COST CATEGORY DESCRIPTIONS		ACQUISITION: RIVER INTAKE	ACQUISITION: TRANSMISSION	ACQUISITION: PUMP STATION	ACQUISITION: PURCHASED WATER
OPER SUPERVISION	CURRENT	40.00		12.59	
	YTD	460.00			
OPER ENGINEERING	CURRENT				
	YTD				
OPER MISCELLANEOUS OTHER EXPENSES	CURRENT				
	YTD				
OPERATION LABOR	CURRENT	166.52		63.66	
	YTD	1843.04			
OPERATION - OTHER EXP	CURRENT				
	YTD				
WATER PURCHASED	CURRENT				
	YTD				
BUILDING SERVICES	CURRENT				
	YTD				
GROUNDS MAINTENANCE	CURRENT			73.49	
	YTD	146.01			
OTHER EXPENSES	CURRENT				
	YTD	49.00			
MAINT SUPERVISION	CURRENT	46.00		5.22	
	YTD	460.00			
MAINT ENGINEERING	CURRENT				
	YTD				
MAINT ENGINEERING OTHER EXPENSES	CURRENT				
	YTD				
MAINT STRUCT & IMPROVEMENTS - LABOR	CURRENT				
	YTD				
MAINT STRUCT & IMPROV - OTHER EXP	CURRENT			7.20	
	YTD	28.78		201.53	
MAINT OF RIVER INTAKE - LABOR	CURRENT				
	YTD	136.61			
MAINT OF RIVER INTAKE - OTHER EXP	CURRENT				
	YTD	2.15			
MAINT OF SUPPLY MAINS - LABOR	CURRENT				
	YTD				

Figure 4. Level IV report - detail of costs by cost center.

WORKLY
ENDING: DECEMBER 31, 1983

LEVEL III SUMMARY OF COST
FOR
KENTON COUNTY KENTUCKY

FUNCTION:		ACQUISITION	TREATMENT	DELIVERY	SUPPORT SERVICES	INTEREST	TOTAL	TAXES	TOTAL WITH TAXES
COST CATEGORY									
PAYROLL COSTS:									
MANAGEMENT AND SUPERVISION	MONTHLY	92.00	276.00	920.00	1,774.74		3,062.74		3,062.74
	YTD	736.00	2,207.00	11,425.00	17,145.14		34,113.14		34,113.14
OPERATION LABOR	MONTHLY	166.32	5,109.84	1,968.00			7,243.76		7,243.76
	YTD	1,907.62	58,335.61	21,084.35			77,287.58		77,287.58
MAINTENANCE LABOR	MONTHLY	85.36	2,690.47	5,302.66			8,038.89		8,038.89
	YTD	639.59	49,365.80	42,770.41			92,765.80		92,765.80
OTHER LABOR	MONTHLY	0.00	0.00	6,466.65	6,986.82		13,453.47		13,453.47
	YTD	0.00	2,619.55	64,529.88	89,357.63		156,507.06		156,507.06
TOTAL	MONTHLY	303.68	8,006.31	14,663.31	8,761.56		31,734.86		31,734.86
	YTD	3,483.31	91,118.04	189,569.68	106,502.75		350,673.74		350,673.74
BENEFITS	MONTHLY				22,975.07		22,975.07		22,975.07
	YTD				135,772.17		135,772.17		135,772.17
TOTAL PAYROLL COST:	MONTHLY	303.68	8,006.31	14,663.31	31,736.63		54,709.93		54,709.93
	YTD	3,483.31	91,118.04	189,569.68	242,274.92		486,845.91		486,845.91
OTHER DIRECT COSTS:									
MAINTENANCE	MONTHLY	7.20	200.25	7,569.58			7,777.03		7,777.03
	YTD	1,210.18	12,804.53	58,701.71			72,716.42		72,716.42
CHEMICALS	MONTHLY		9,855.40				9,855.40		9,855.40
	YTD		112,466.26				112,466.26		112,466.26
POWER	MONTHLY	5,257.97	602.01	34,503.53			40,363.51		40,363.51
	YTD	67,517.68	7,409.96	445,359.81			520,287.45		520,287.45
MISCELLANEOUS	MONTHLY	40.27	1,623.45	-423.31	1,772.72		3,013.53		3,013.53
	YTD	775.55	19,443.32	1,454.57	108,846.77		130,520.24		130,520.24
TOTAL	MONTHLY	5,305.44	12,341.11	41,649.80	1,772.72		61,069.07		61,069.07
	YTD	69,503.61	152,124.07	505,525.09	108,846.77		835,998.37		835,998.37

Figure 5. Level III report - summary of costs by function.

FUNKLY
ENDING DECEMBER 31, 19[illegible]

LEVEL III SUMMARY OF COST
FOR
KENTON COUNTY KENTUCKY

PAGE 2 OF 2

	FUNCTIONS	ACQUISITION	TREATMENT	DELIVERY	SUPPORT SERVICES	INTEREST	TOTAL	TAXES	TOTAL WITH TAXES
COST CATEGORY									
TOTAL PAYROLL AND OTHER DIRECT COSTS	MONTHLY	5,609.12	20,[illegible]07.46	5[illegible],25[illegible].37	[illegible]3,5[illegible]8.8[illegible]		115,778.[illegible]		115,778.9[illegible]
	ITD	72,[illegible]86.95	2[illegible],9[illegible].11	[illegible]65,[illegible]9[illegible].[illegible]3	351,[illegible]01.[illegible]		[illegible],[illegible]27,[illegible]24.[illegible]		[illegible],[illegible]27,[illegible]24.[illegible]
DEPRECIATION	MONTHLY	536.91	2,723.5[illegible]	14,[illegible]48.79	1,5[illegible]0.8[illegible]		19,779.11		19,779.11
	ITD	6,[illegible]42.92	32,6[illegible]2.96	17[illegible],385.48	18,729.96		237,241.32		237,241.32
TOTAL	MONTHLY	6,146.03	23,131.[illegible]	71,201.[illegible]	35,0[illegible]6.8[illegible]		135,[illegible]48.01		135,[illegible]48.01
	ITD	79,[illegible]29.87	275,[illegible]25.07	[illegible],[illegible]81.01	3[illegible],831.[illegible]		1,5[illegible],[illegible]07.[illegible]		1,5[illegible],[illegible]07.[illegible]
INTEREST	MONTHLY					1,[illegible]56.15	1,9[illegible]6.15		1,9[illegible]6.15
	ITD					10,428.46	10,428.46		10,429.46
TAXES	MONTHLY							[illegible].[illegible]	[illegible].[illegible]
	ITD							[illegible].[illegible]	[illegible].[illegible]
TOTAL	MONTHLY	6,146.03	23,131.[illegible]	71,201.[illegible]	35,069.[illegible]	1,956.15	137,505.16	0.00	137,505.16
	ITD	79,[illegible]29.87	275,[illegible]25.07	[illegible],[illegible]81.01	3[illegible],831.[illegible]	10,[illegible]28.[illegible]	1,5[illegible],[illegible]95.[illegible]	[illegible].[illegible]	1,5[illegible],[illegible]95.[illegible]

Figure 5. (continued)

COST COMPARISON REPORT

AS OF DATE: DECEMBER 31, 1986
AFI PERIOD: MONTHLY (6 WKS)
FYD START: JANUARY 1, 1986

REGION COUNTY KENTUCKY
(LEVEL II)

COMPARISON OF ACTUAL COST TO BUDGET COST:

BUDGET CATEGORIES		ACTUAL COSTS		BUDGETED COSTS		VARIANCE YEAR TO DATE	
ACCT #	ACCOUNT NAME	CURR PERIOD	YR TO DATE	YR TO DATE	ANNUAL BUD	BALANCE	PERCENT
920-13	UTILITIES	49.76	647.74	[illegible]	800.00	116.26	84.8
920-95	SALARY		42.30	50.00	50.00	21.70	84.6
905-50	OTHER EXPENSES		.46	250.00	250.00	249.54	.2
905-51	INTEREST EXPENSE DEPOSIT GUARANTEE	352.00	8,511.00	13,000.00	13,000.00	4,489.00	34.7
ADMINISTRATIVE AND GENERAL							
920-01	OPER SUPERVR & MANAGEMENT	1,068.00	18,956.20	21,000.00	21,000.00	2,043.80	90.3
920-02	FINANCIAL ACCOUNTING/CONTR-BUDG	1,231.00	23,338.00	10,000.00	10,000.00	-13,338.00	233.4 *
920-50	FINANCIAL ACCOUNTING/PROGRAM-OTHER		170.00	200.00	200.00	30.00	85.0
921-03	BUILDING SERVICES	177.50	2,573.43	2,500.00	2,500.00	-73.43	102.9 *
921-04	COMMUNICATIONS	-215.81	1,090.66	1,250.00	1,250.00	159.34	87.2
921-13	UTILITIES	59.76	757.14	750.00	750.00	-7.14	100.9 *
921-15	OFFICE SUPPLIES	62.31	604.00	500.00	500.00	-104.00	120.8 *
921-16	AUTO MAINTENANCE	5.00	934.72	650.00	350.00	-584.72	267.1 *
921-27	AUTO GAS & OIL	101.02	847.39	400.00	400.00	-447.39	211.8 *
921-28	DUES & SUBSCRIPTIONS		508.21	500.00	500.00	-8.21	101.6 *
921-29	TRAVEL	806.00	1,806.39	1,000.00	1,000.00	-806.39	180.6 *
921-50	OTHER EXPENSES		4.00	50.00	50.00	46.00	8.0
923-00	PROFESSIONAL FEES	175.00	5,933.87	15,000.00	15,000.00	9,066.13	39.2
924-00	PROPERTY INSURANCE		11,425.80	12,500.00	12,500.00	1,074.20	91.4
925-00	INJURIES & DAMAGES	-2,083.31	38,364.82	27,500.00	27,500.00	-10,864.82	139.5 *
926-00	EMPLOYEE PENSIONS & BENEFITS	19,477.34	102,281.20	105,000.00	105,000.00	2,718.80	97.4
926-21	FICA	3,139.12	31,901.62	27,500.00	27,500.00	-4,401.62	116.0 *
926-22	STATE UNEMPLOYMENT TAX	87.57	1,983.99	1,750.00	1,750.00	-233.99	113.4 *
926-23	PAYROLL TAXES - CITY	406.61	1,509.35	2,500.00	2,500.00	990.65	60.4
926-50	OBL EXPENSE			100.00	100.00	100.00	
930-00	MISCELLANEOUS GENERAL EXPENSES			250.00	250.00	250.00	
930-50	OTHER EXPENSES		1,447.81	2,000.00	2,000.00	552.19	72.4
932-39	MAINT OF BUILDING	66.00	191.49	2,500.00	2,500.00	2,308.51	7.7
934-40	MAINT EQUIPMENT		737.97	1,250.00	1,250.00	512.03	59.0
934-50	OTHER EXPENSES			150.00	150.00	150.00	
TOTAL ACTUAL COSTS TO BUDGET		116,386.35	1,368,726.05	1,211,265.00	1,211,265.00	-157,461.05	113.0 *
NON BUDGETED COSTS							
933-50	MAINT EQUIPMENT - OTHER EXPENSES						
864-50	EQUIPMENT EXP CR (CR)	-4,394.00	-33,193.00				
864-51	OVERHEAD EXP CR (CR)	-1,214.95	-13,136.77				
TOTAL		115,778.40	1,322,426.28	1,211,265.00	1,211,265.00	-111,161.28	109.2 *
DEPRECIATION		19,770.11	237,241.34				
TOTAL		135,549.01	1,559,667.60	1,211,265.00	1,211,265.00	-348,402.60	128.8 *
INTEREST		1,956.15	10,828.46				
TAXES							
TOTAL		137,505.16	1,570,496.06	1,211,265.00	1,211,265.00	-359,231.06	129.6 *

Figure 6. Level II report - cost comparison.

COST COMPARISON REPORT

RPT PERIOD: MONTHLY (4 WKS)	MARION COUNTY KENTUCKY	
ITD START: JANUARY 1, 1980	(LEVEL II)	

COMPARISON OF ACTUAL COSTS TO PRIOR YEAR

COST CATEGORIES	ACTUAL COSTS CURRENT YEAR (YTD)	ACTUAL COSTS PREVIOUS YEAR (YTD)	VARIANCE TO TO DATE DOLLARS	PERCENT	
ACQUISITION					
PAYROLL COSTS:					
MANAGEMENT & SUPRV	936.10	799.40	-136.70	117.1	*
OPERATION LABOR	1,907.64	1,679.46	-228.18	101.4	*
MAINTENANCE LABOR	639.59	1,030.77	391.18	62.0	
OTHER LABOR		49.77	49.77		
BENEFITS					
OTHER DIRECT COSTS:					
MAINTENANCE	1,210.10	4,123.40	2,913.22	29.3	
CHEMICALS					
POWER	67,517.96	57,775.71	-9,742.17	116.9	*
MISCELLANEOUS	775.50	1,045.37	269.77	72.4	
DEPRECIATION	5,547.92	5,547.92		100.0	
TOTAL COST OF ACQUISITION	79,429.87	73,162.80	-6,267.07	108.6	*
TREATMENT					
PAYROLL COSTS:					
MANAGEMENT & SUPRV	4,807.00	4,173.80	-633.20	115.2	*
OPERATION LABOR	54,335.61	47,707.40	-6,628.21	113.9	*
MAINTENANCE LABOR	29,355.88	17,155.00	-12,200.88	171.1	*
OTHER LABOR	2,619.55	2,022.35	-597.20	129.5	*
BENEFITS					
OTHER DIRECT COSTS:					
MAINTENANCE	12,804.53	9,322.13	-3,482.40	137.4	*
CHEMICALS	112,466.26	109,349.77	-3,116.49	102.9	*
POWER	7,809.96	31,307.14	23,897.18	23.7	
MISCELLANEOUS	15,443.32	15,379.32	-64.00	145.4	*
DEPRECIATION	32,682.96	32,682.96		100.0	
TOTAL COST OF TREATMENT	278,925.07	265,099.91	-6,825.16	102.6	*
DELIVERY					
PAYROLL COSTS:					
MANAGEMENT & SUPRV	11,245.00	11,039.44	-185.55	101.7	*
OPERATION LABOR	21,048.35	18,863.22	-2,181.13	111.6	*
MAINTENANCE LABOR	52,770.41	49,490.59	-3,279.82	107.1	*
OTHER LABOR	64,529.88	52,986.13	-11,543.75	121.8	*
BENEFITS					
OTHER DIRECT COSTS:					
MAINTENANCE	58,761.71	52,831.80	-6,063.91	111.4	*

Figure 6. (continued)

SUMMARY OF SYSTEMS INFORMATION

DATE: DECEMBER 31, 1980 — PAGE: 1

FOR

HARTON COUNTY KENTUCKY

(LEVEL I)

CATEGORY	ACQUISITION	TREATMENT	DELIVERY	SUPPORT	INTEREST	TOTAL	TAXES	TOTAL
CURRENT PERIOD UNIT COST $/MG	25.22	98.90	292.12	143.88	8.03	568.15		568.15
PREVIOUS PERIOD UNIT COST $/MG	28.02	90.54	289.34	88.94	3.02	494.84		494.84
CURRENT PERIOD PREVIOUS YEAR $/MG	28.24	78.77	253.78	126.89	5.16	492.86		492.86
CURRENT YEAR (YTD) UNIT COST $/MG	25.83	89.64	271.10	120.15	3.39	510.08		510.08
PREVIOUS YEAR (YTD) UNIT COST $/MG	25.06	92.19	238.82	112.99	19.88	488.94		488.94
CURRENT PERIOD TOTAL COST	6146.03	23131.44	71201.86	35069.66	1956.15	137505.16		137505.16
YEAR TO DATE TOTAL COST	79429.87	275925.07	834681.01	369831.65	10428.46	1570096.06		1570096.06
% OF TOTAL YEAR TO DATE	5.06	17.57	53.15	23.55	.66			100.00
% OF PREVIOUS YEAR (YTD)	5.13	18.85	48.84	23.11	8.07			100.00
BUDGET VARIANCE YEAR TO DATE								113.00
TREATED WATER CURRENT PERIOD								285.51
REVENUE PRODUCING WATER CURRENT PERIOD								243.74
REVENUE PRODUCING WATER (YTD)								3078.16
REVENUE PRODUCING WATER PREVIOUS YTD								2919.08

Figure 7. Level I report - summary of systems information.

Acquisition, Treatment, etc. Level II compares the current period costs (month for example) to the year-to-date costs and the Level I report simply summarizes data on a dollars per million gallon basis by major function and for several categories of accounting detail.

APPLICATION TO WASTEWATER

This matrix concept has been extended to the Tampa, Florida drinking water utility and to its' wastewater utility as well.[5] Figure 8 is a schematic of a representative wastewater utility system analagous to the water utility schematic in Figure 1. The major functions are listed as collection, treatment and disposal. Wastewater including infiltration and inflow and combined sewer contributions is collected and passed through several pumping stations into the treatment plant, which in this particular case, is subdivided into liquids processing and sludge treatment. Effluent is then discharged through a pump into a receiving body of water and the sludge is disposed of at an off-site location. Support services costs including interest, taxes, and other applicable costs are applied across the functional subdivisions.

Figure 9 shows the City of Tampa Sewer Department cost centers schematic in which the various service zones are identified, along with assigned accounting codes. Tampa has numerous pump stations because of its flat terrain and two treatment plants. Wastewater passes through the pump stations, through the various service zones, where it may be repumped, to the treatment plant, and is then discharged to a receiving body of water.

Figure 10 illustrates how the cost analysis system might be utilized to assign a cost to a particular user. In the illustration, wastewater is discharged from the Anheuser-Busch plant, through the Louisiana Street pump station, to the Krause Street pump station, and is finally transported to the Hooker's Point treatment plant. The dollar figures on the schematic are

ORIGINAL CONCEPT

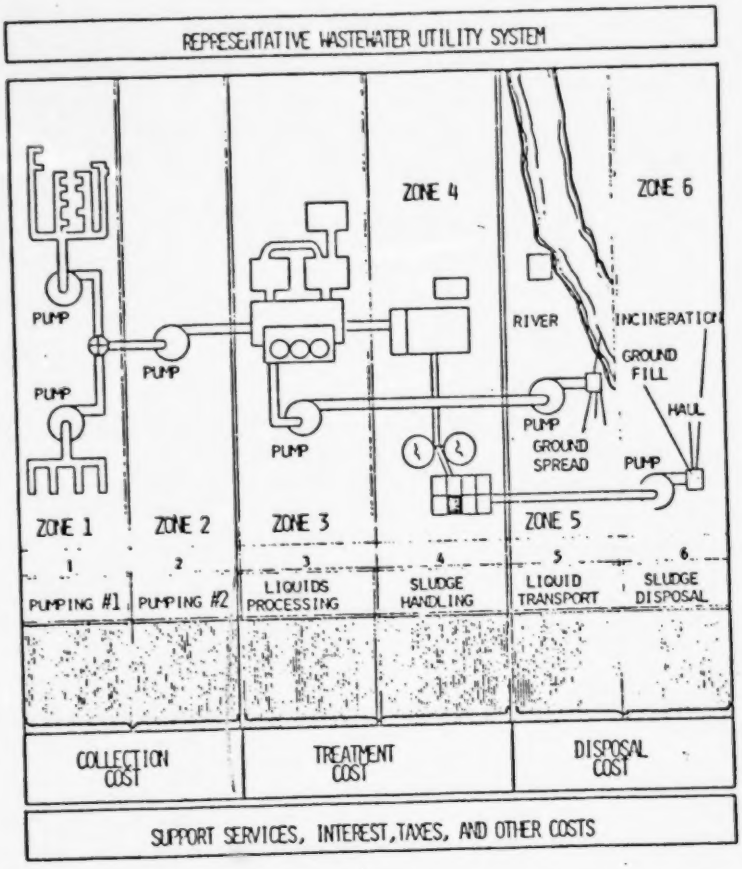


Figure 8. Simplified Schematic Wastewater Cost Identification concept

Figure 9.

(CITY OF TAMPA SANITARY SEWER DEPARTMENT SYSTEM SCHEMATIC)

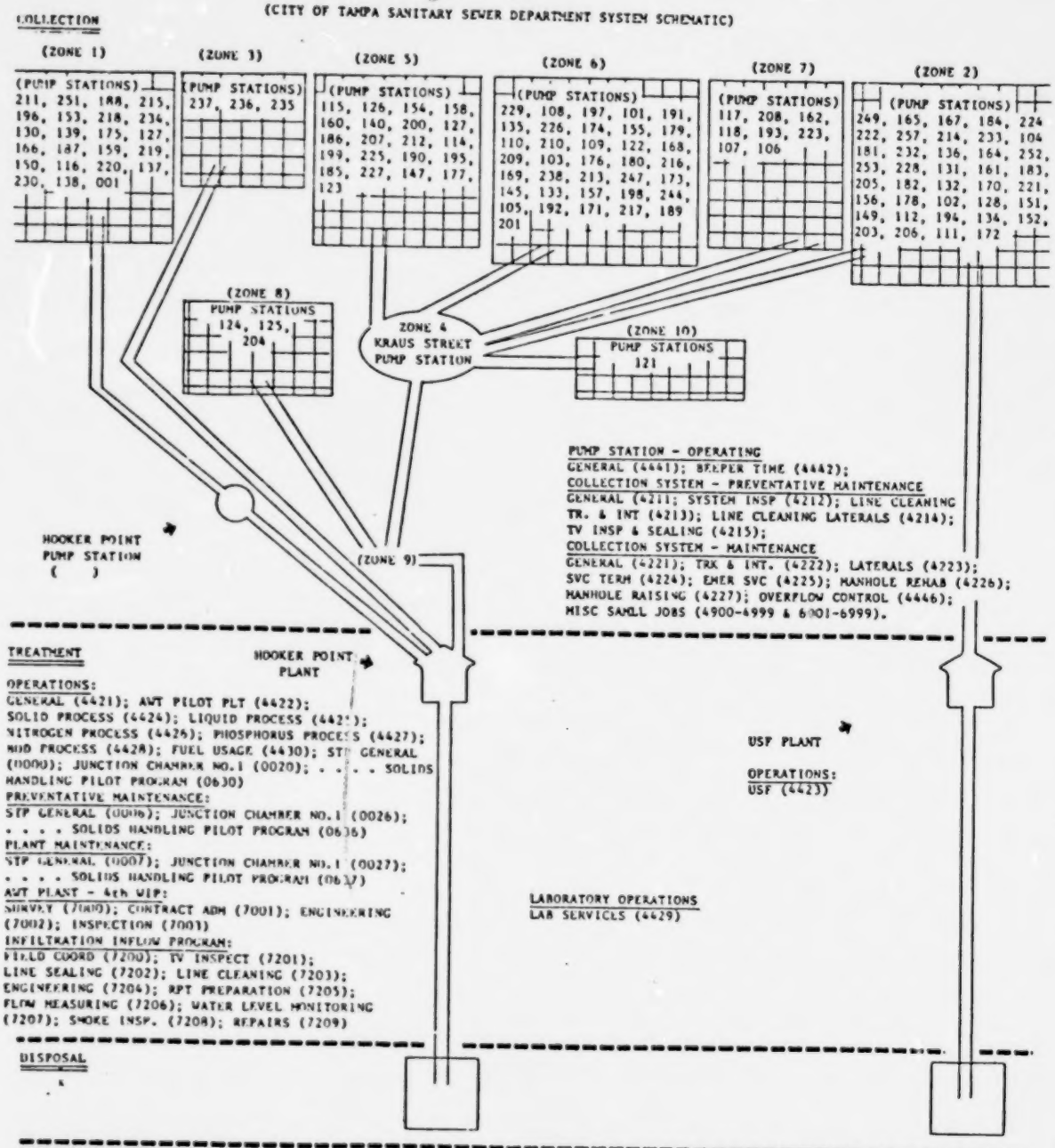
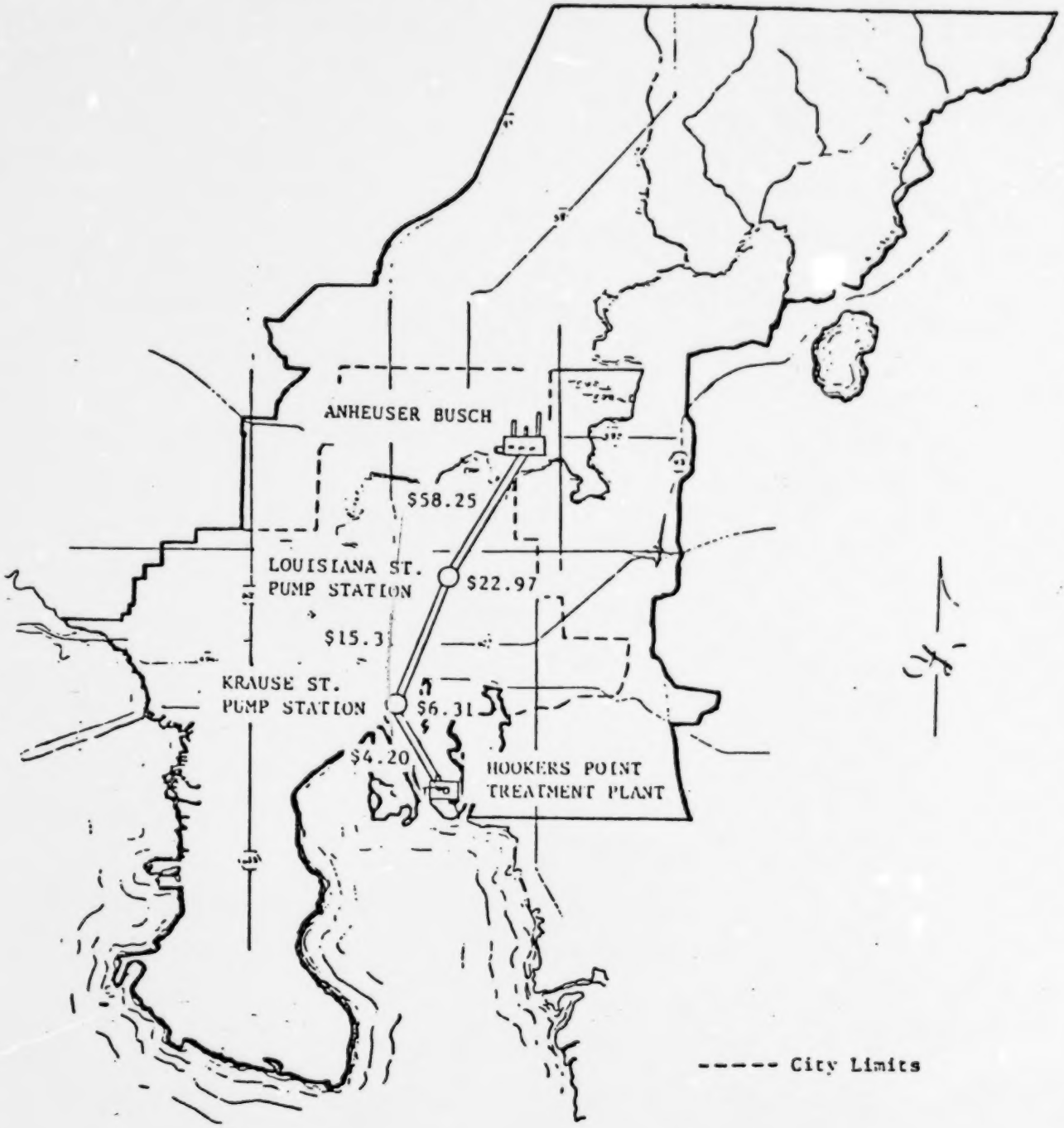

COLLECTION
(ZONE 1)
(PUMP STATIONS)
211, 251, 188, 215, 196, 153, 218, 236, 130, 139, 175, 127, 166, 187, 159, 219, 150, 116, 220, 137, 230, 138, 001
(ZONE 3)
(PUMP STATIONS)
237, 236, 235
(ZONE 5)
(PUMP STATIONS)
115, 126, 154, 158, 160, 140, 200, 127, 186, 207, 212, 114, 199, 225, 190, 195, 185, 227, 147, 177, 123
(ZONE 6)
(PUMP STATIONS)
229, 108, 197, 101, 191, 135, 226, 174, 155, 179, 110, 210, 109, 122, 168, 209, 103, 176, 180, 216, 169, 238, 213, 247, 173, 145, 133, 157, 198, 244, 105, 192, 171, 217, 189, 201
(ZONE 7)
(PUMP STATIONS)
117, 208, 162, 118, 193, 223, 107, 106
(ZONE 2)
(PUMP STATIONS)
249, 165, 167, 184, 224, 222, 257, 214, 233, 104, 181, 232, 136, 164, 252, 253, 228, 131, 161, 183, 205, 182, 132, 170, 221, 156, 178, 102, 128, 151, 149, 112, 194, 134, 152, 203, 206, 111, 172
(ZONE 8)
PUMP STATIONS
124, 125, 204
ZONE 4
KRAUS STREET
PUMP STATION
(ZONE 10)
PUMP STATIONS
121
HOOKER POINT
PUMP STATION
( )
(ZONE 9)
PUMP STATION - OPERATING
GENERAL (4441); BEEPER TIME (4442);
COLLECTION SYSTEM - PREVENTATIVE MAINTENANCE
GENERAL (4211; SYSTEM INSP (4212); LINE CLEANING TR. & INT (4213); LINE CLEANING LATERALS (4214); TV INSP & SEALING (4215);
COLLECTION SYSTEM - MAINTENANCE
GENERAL (4221); TRK & INT. (4222); LATERALS (4223); SVC TERM (4224); EMER SVC (4225); MANHOLE REHAB (4226); MANHOLE RAISING (4227); OVERFLOW CONTROL (4446); MISC SMALL JOBS (4900-4999 & 6001-6999).
TREATMENT
HOOKER POINT PLANT
OPERATIONS:
GENERAL (4421); AWT PILOT PLT (4422); SOLID PROCESS (4424); LIQUID PROCESS (4425); NITROGEN PROCESS (4426); PHOSPHORUS PROCESS (4427); HDD PROCESS (4428); FUEL USAGE (4430); STP GENERAL (0000); JUNCTION CHAMBER NO.1 (0020); . . . . SOLIDS HANDLING PILOT PROGRAM (0630)
PREVENTATIVE MAINTENANCE:
STP GENERAL (0006); JUNCTION CHAMBER NO.1 (0026); . . . . SOLIDS HANDLING PILOT PROGRAM (0636)
PLANT MAINTENANCE:
STP GENERAL (0007); JUNCTION CHAMBER NO.1 (0027); . . . . SOLIDS HANDLING PILOT PROGRAM (0637)
AWT PLANT - 4th WIP:
SURVEY (7000); CONTRACT ADM (7001); ENGINEERING (7002); INSPECTION (7003)
INFILTRATION INFLOW PROGRAM:
FIELD COORD (7200); TV INSPECT (7201); LINE SEALING (7202); LINE CLEANING (7203); ENGINEERING (7204); RPT PREPARATION (7205); FLOW MEASURING (7206); WATER LEVEL MONITORING (7207); SMOKE INSP. (7208); REPAIRS (7209)
USF PLANT
OPERATIONS:
USF (4423)
LABORATORY OPERATIONS
LAB SERVICES (4429)
DISPOSAL
SUPPORT SERVICES
ADMINISTRATIVE OPERATIONS:
GENERAL (4001); EXECUTIVE (4002); CUSTOMER SVC (4003); ACCOUNTING (4004); CONTRACT ADM (4005); CODING (4006); SPOT CHECKING (4007); BATCHING (4008); TRANS VERIF & SIGN OFF (4009); SICK LEAVE (4820). . . . UNION ACTIVITIES (4828)
ENGINEERING OPERATIONS:
GENERAL (4101); INSP GENERAL (4103); INSP UTIL (4104); INSP DEVELOPER (4105); INSP & SURVEY TRAINING (4106);
ENGINEERING SURVEY:
GENERAL (4102)
ENGINEERING PLANNING:
GENERAL (4111); FLOW MEASURING (4112)
ENGINEERING DESIGN
GENERAL (4121); DEVELOPER REVIEW (4122); UTIL REVIEW (4123);
ENGINEERING LEAVE CONTROL:
SICK LEAVE (4830). . . . . ADMIN LEAVE (4837)
MAINTENANCE - YARD - ADMIN:
OPERATING (4201); EQUIPMENT CONTROL (4202); MATERIAL CONTROL (4203); DISPATCHER (4204); BEEPER TIME (4205); TRAINING (4206); SICK LEAVE (4840). . . . UNION ACTIVITIES (4848)
TREATMENT DIV - ADMIN:
TRAINING (4400); GENERAL (4401); SICK LEAVE (4800). . . . ADMIN LEAVE (4807)
TREATMENT - TECHNICAL SVCS:
GENERAL (4402); INDUST.WASTE GENERAL (4403); INDUST. WASTE FIELD (4406); DRW STORM WATER ANALYSIS (4407); SANITARY SAMPLING (4408); BAY STUDY (4403); SEA GRANT (4404)
MATERIAL HANDLING:
ADMIN (4431); RECEIVING (4432); ISSUING (4433)
MAINTENANCE-EQUIPMENT CONTROL:
TRUCKS (4700); SM DUMP TRUCK (4701); . . . SUPERVISION (4720)

Fig. 10. CITY OF TAMPA SANITARY SEWERS GENERALIZED SCHEMATIC



costs in $/million gallons. These costs could be accumulated, added to the unit treatment cost, including any specialised treatment costs that would be associated with the Anheuser-Busch waste, and the total cost used as the basis for a charge to Anheuser-Busch.

Figure 11 illustrate Tampa's Hookers Point plant broken down into individual unit treatment processes. O&M and depreciation have been allocated to the various functions within the plant. This process would allow costs to be allocated against the individual user. Costs could also be calculated on some basis other then $/mil gal. For examples costs could be calucated based upon organic loading.

DATA ANALYSIS

Because the cost analysis system has been operating for only one year in Tampa, in this section examples of data analysis based on 10 years of historical records for Tampa will be examined.[8] The historical costs are reported in the same format as they would be in the cost analysis system. Figure 12 shows a 10-year cost history of power and chemicals costs for Tampa from 1970 to 1979. As can be seen in the figure, when the advanced waste treatment system was installed (1977-1978), the power and chemical costs increased markedly. Figure 13 illustrates the increases over 10 years for payroll and labor. The growing difference between these two lines illustrates the increasing impact that benefit payments have had on payroll costs. Figure 14 is a plot of total treatment costs, broken down into costs for sludge handling and liquids processing.

These figures are typical of the kinds of information that can be developed from the cost analysis system. Figures 15, 16, and 17 show the percent of total annual expenditures for collection, treatment and support services, depreciation, operation and maintenance and total annual cost. As

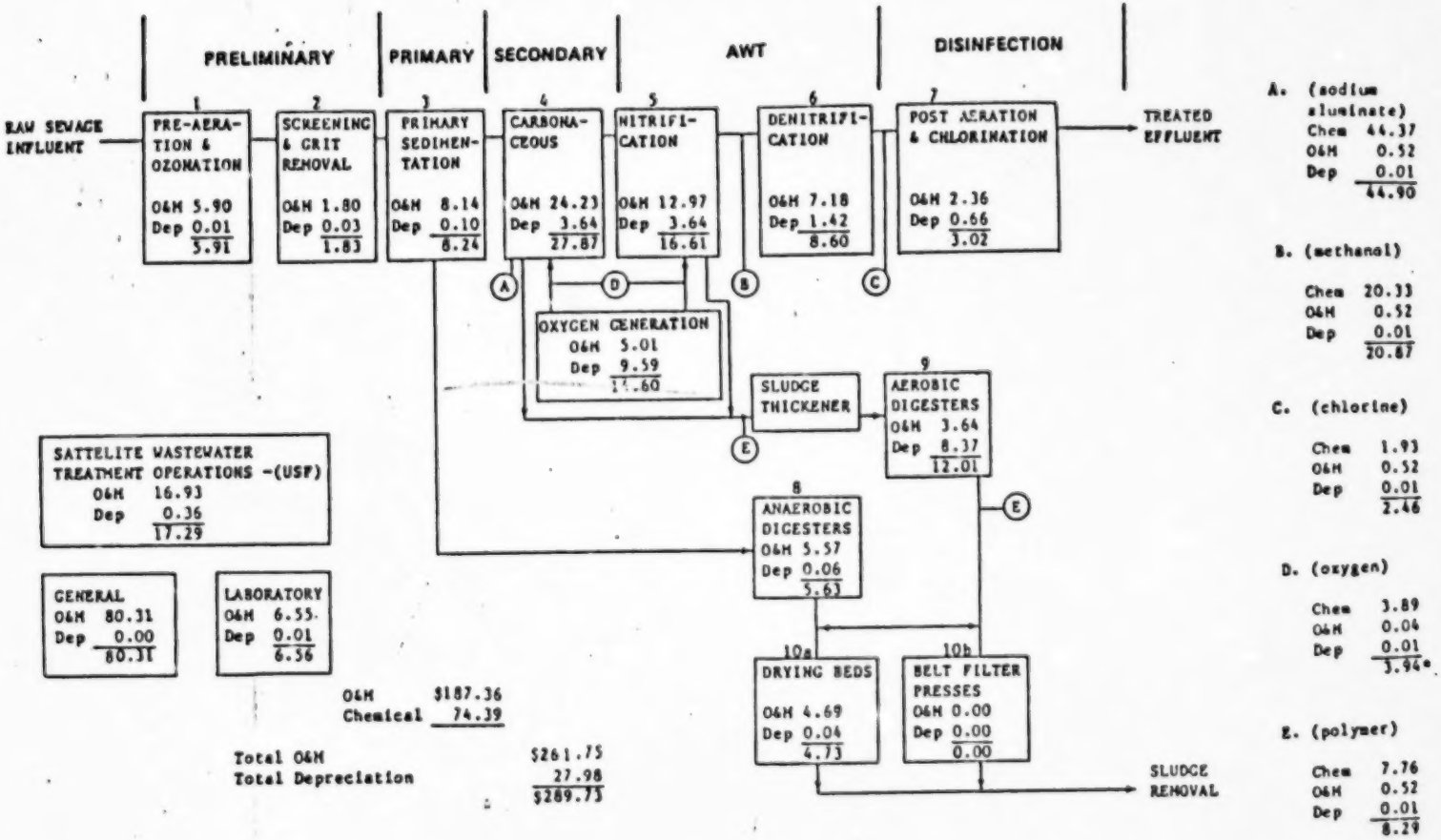

PRELIMINARY
PRIMARY
SECONDARY
AWT
DISINFECTION
RAW SEWAGE INFLUENT
1 PRE-AERATION & OZONATION O&M 5.90 Dep 0.01 5.91
2 SCREENING & GRIT REMOVAL O&M 1.80 Dep 0.03 1.83
3 PRIMARY SEDIMENTATION O&M 8.14 Dep 0.10 8.24
4 CARBONACEOUS O&M 24.23 Dep 3.64 27.87
5 NITRIFICATION O&M 12.97 Dep 3.64 16.61
6 DENITRIFICATION O&M 7.18 Dep 1.42 8.60
7 POST AERATION & CHLORINATION O&M 2.36 Dep 0.66 3.02
TREATED EFFLUENT
OXYGEN GENERATION O&M 5.01 Dep 9.59 14.60
SLUDGE THICKENER
9 AEROBIC DIGESTERS O&M 3.64 Dep 8.37 12.01
8 ANAEROBIC DIGESTERS O&M 5.57 Dep 0.06 5.63
10a DRYING BEDS O&M 4.69 Dep 0.04 4.73
10b BELT FILTER PRESSES O&M 0.00 Dep 0.00 0.00
SLUDGE REMOVAL
SATTELITE WASTEWATER TREATMENT OPERATIONS -(USF) O&M 16.93 Dep 0.36 17.29
GENERAL O&M 80.31 Dep 0.00 80.31
LABORATORY O&M 6.55 Dep 0.01 6.56
O&M $187.36
Chemical 74.39
Total O&M $261.75
Total Depreciation 27.98
$289.73
A. (sodium aluminate) Chem 44.37 O&M 0.52 Dep 0.01 44.90
B. (methanol) Chem 20.33 O&M 0.52 Dep 0.01 20.87
C. (chlorine) Chem 1.93 O&M 0.52 Dep 0.01 2.46
D. (oxygen) Chem 3.89 O&M 0.04 Dep 0.01 3.94*
E. (polymer) Chem 7.76 O&M 0.52 Dep 0.01 8.29
* Included as a portion of oxygen generation facility

Figure 11. Tampa Sanitary Sewer Department allocation of O&Mand depreciation cost to treatment processes (1979, all cost in $/MG TWW).

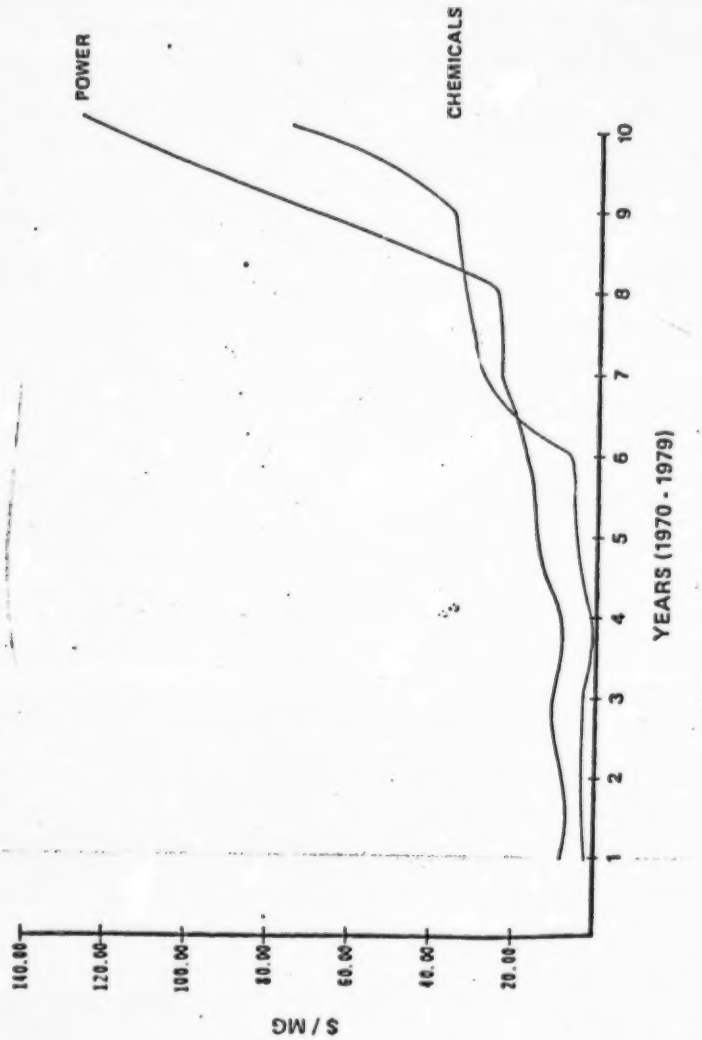


Figure 12. City of Tampa Sanitary Sewer historical operating costs: power and chemicals.

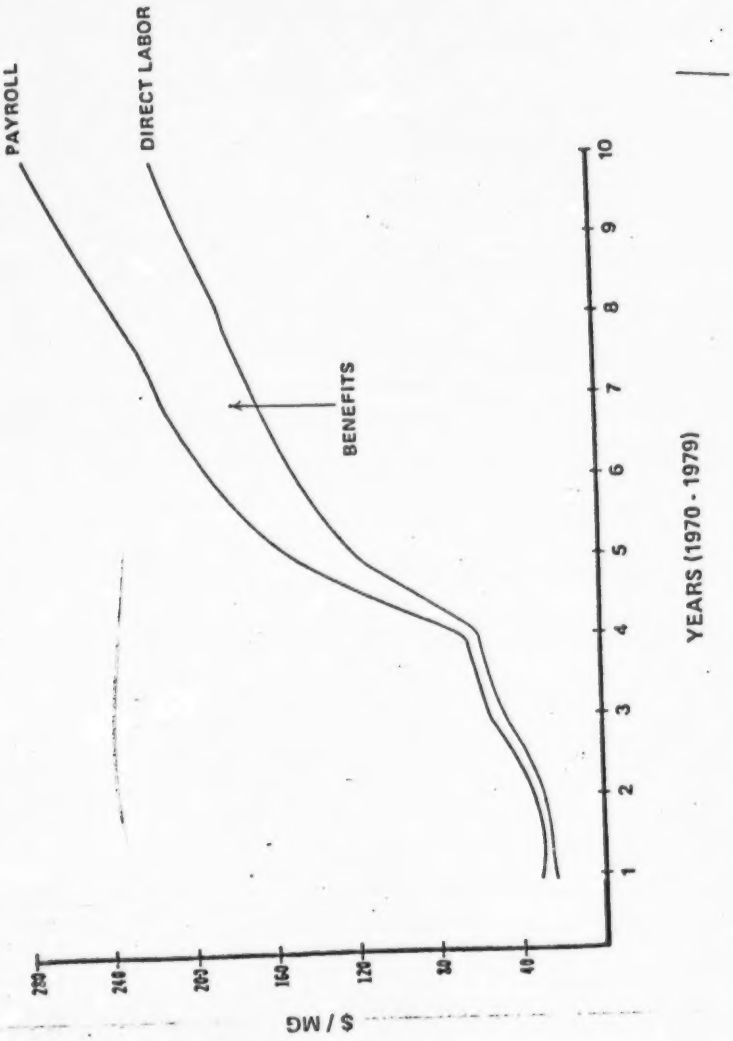


Figure 13. City of Tampa Sanitary Sewer operating costs: payroll vs. fringe benefits.

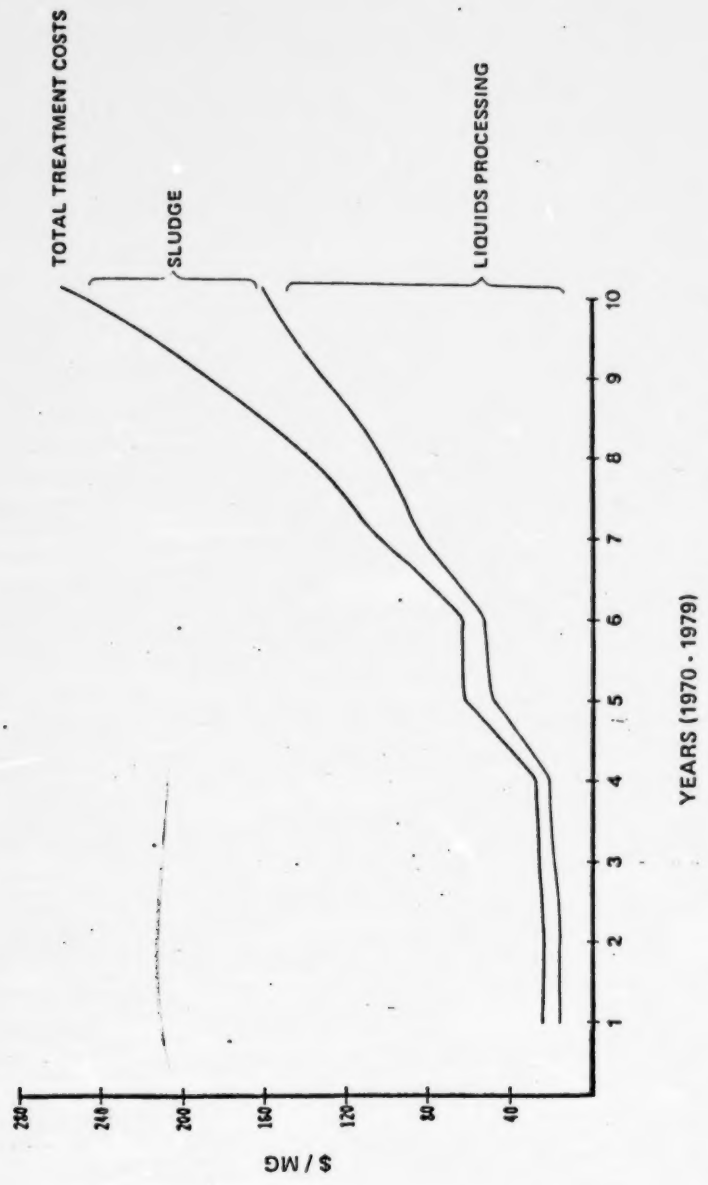


Figure 14. City of Tampa Sanitary Sewer total treatment costs: sludge vs. liquids processing.

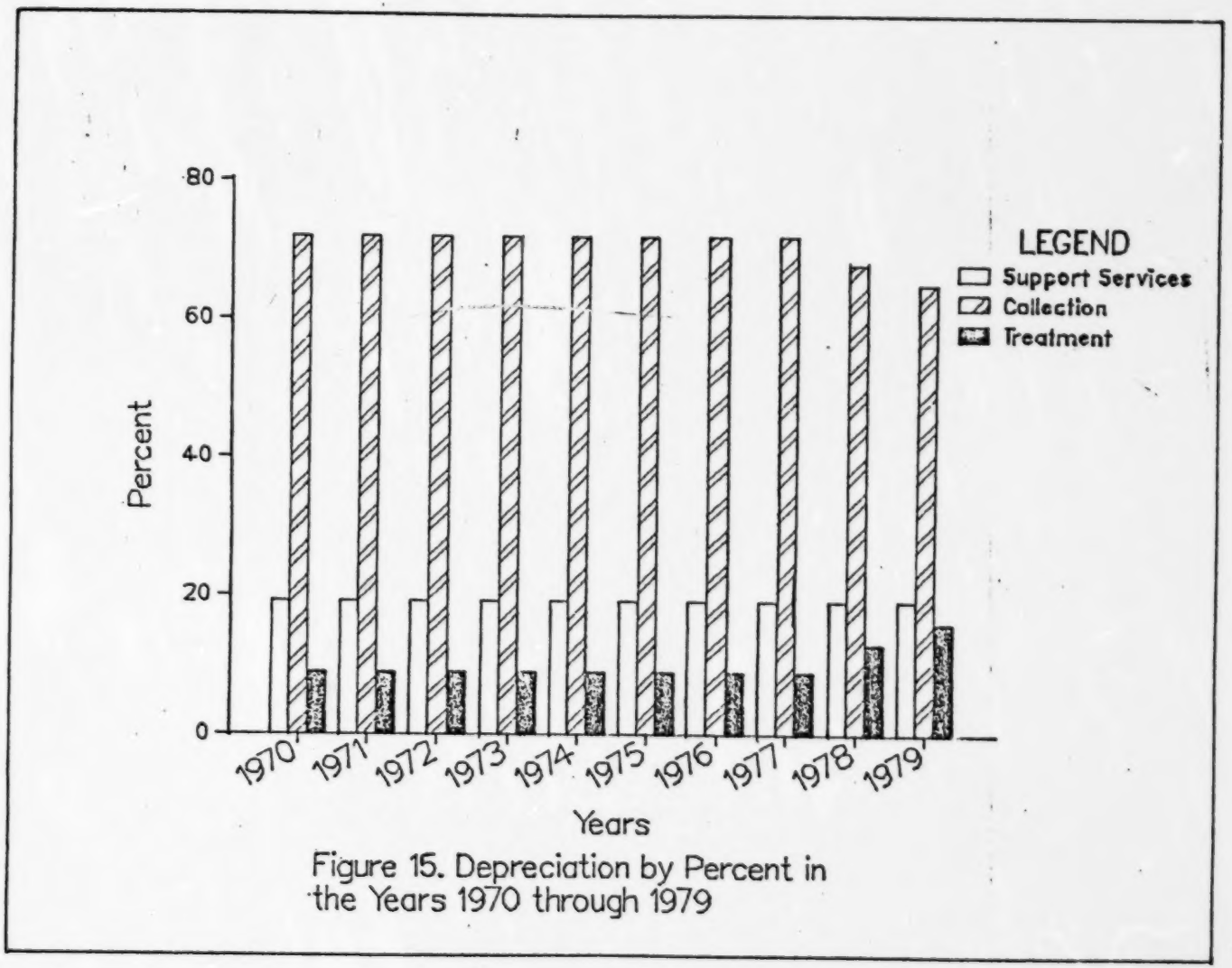


Figure 15. Depreciation by Percent in the Years 1970 through 1979

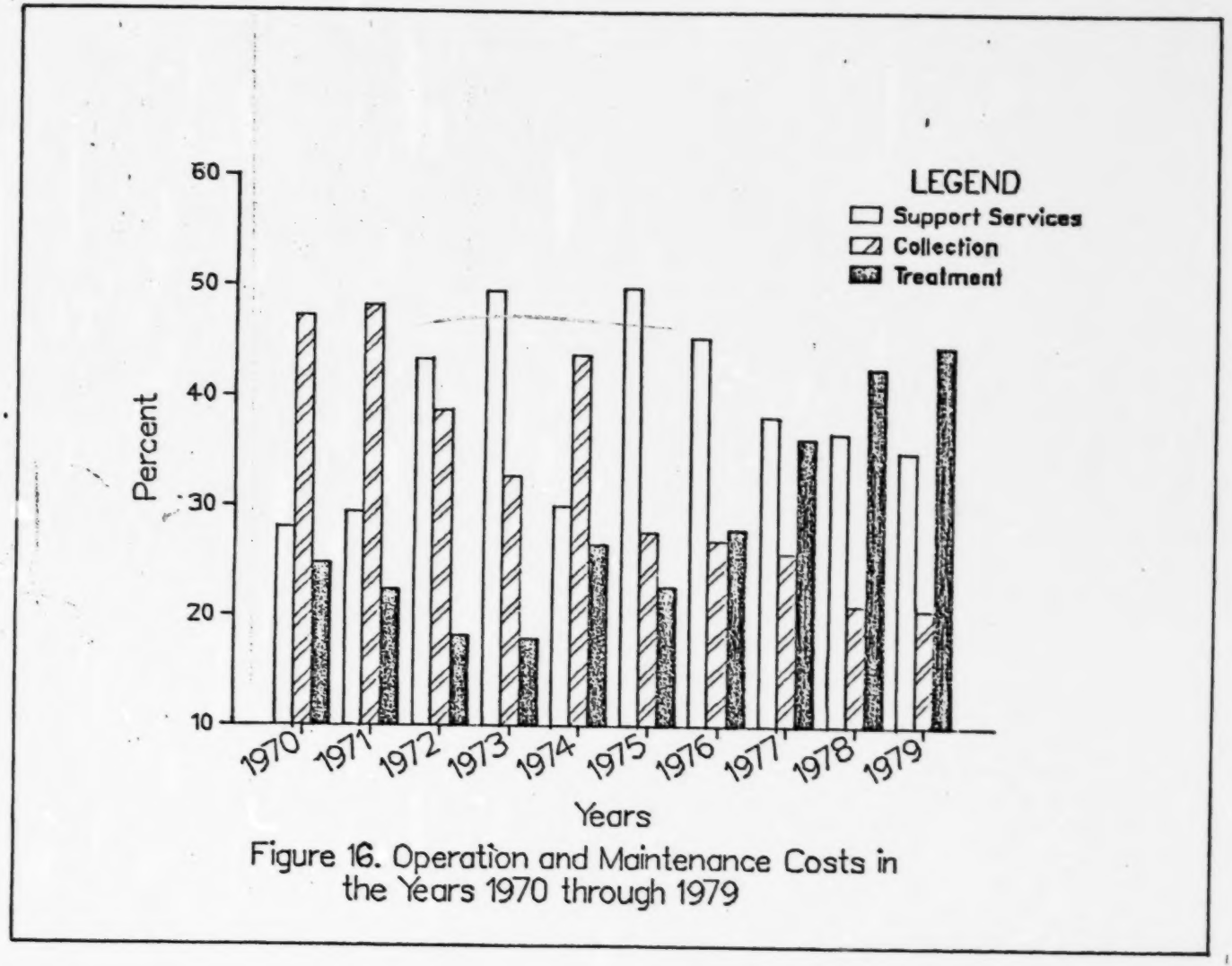


Figure 16. Operation and Maintenance Costs in the Years 1970 through 1979

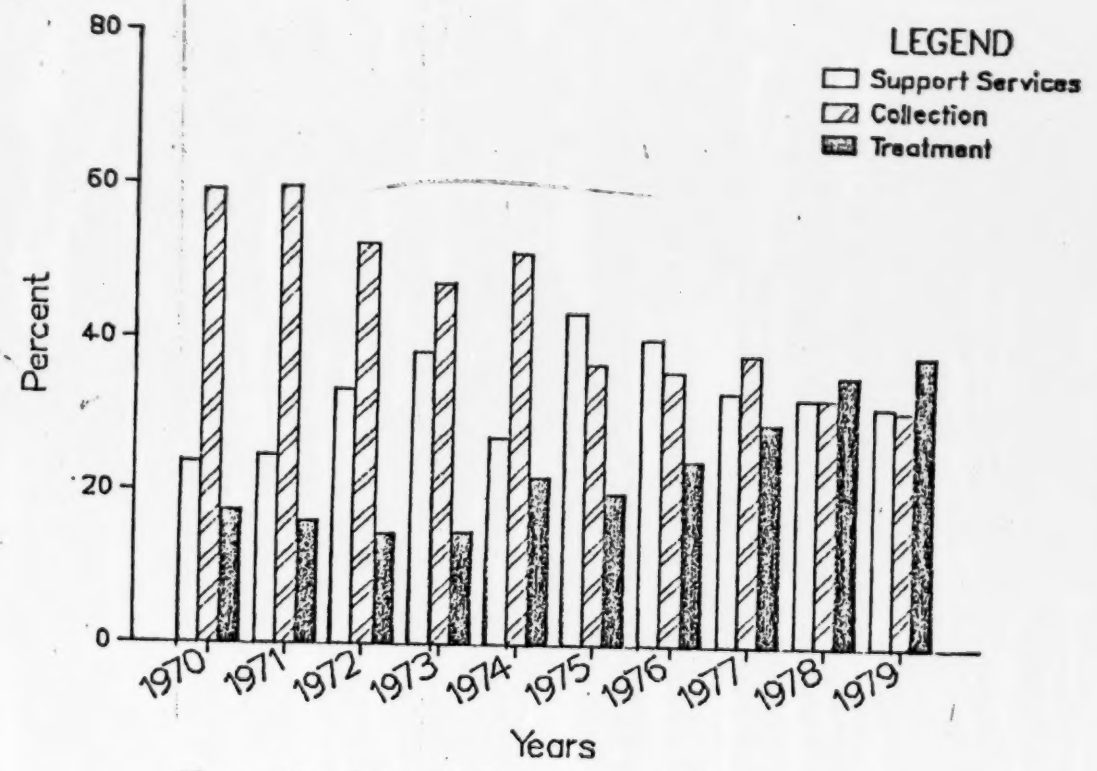


Figure 17. Total O&M + Depreciation Costs as a Percent of Total

can be seen in Figure 15 depreciation rises slightly in 1978-1979 (depreciation will lag installation) when the new advanced waste treatment plant is brought on line. By contrast O&M costs increase dramatically with the installation of the new plant.

An additional kind of analysis that goes beyond cost monitoring is one that monitors revenues. Figure 18 is a plot of accumulated revenues versus expenses from the Kenton County water utility. As can be seen, expenses are frequently higher then revenues. These costs and revenue comparisons can be made for the entire utility, for a given service zone in the utility, or by customer class. These illustrations are provided to demonstrate the potential for special purpose cost monitoring with the cost analysis system.

SUMMARY AND CONCLUSIONS

It is increasingly difficult for the needs for wastewater treatment facilities to be met with Federal and other public funds. The Federal share of the Construction Grants Program will be reduced and may be eliminated entirely. With increasing frequency, funds will be targeted toward priority areas, and cost-effectiveness and water quality impacts will be emphasized. Nevertheless, the need for waste water collection and treatment facilities will grow. Increasingly, therefore, utilities will be expected to construct facilities and operate them on a self-sustaining basis. Examples of a viable approach toward self-sustained financial management of municipal pollution control systems can be drawn from the concepts commonly used by drinking water utilities.

Exemplified by the discussion of financial mangement presented here, systems can be developed which use traditional accounting data to get product costing information that can be used as input to management decisions by engineer/managers. This concept adds a spatial dimension to the management of wastewater utilities.

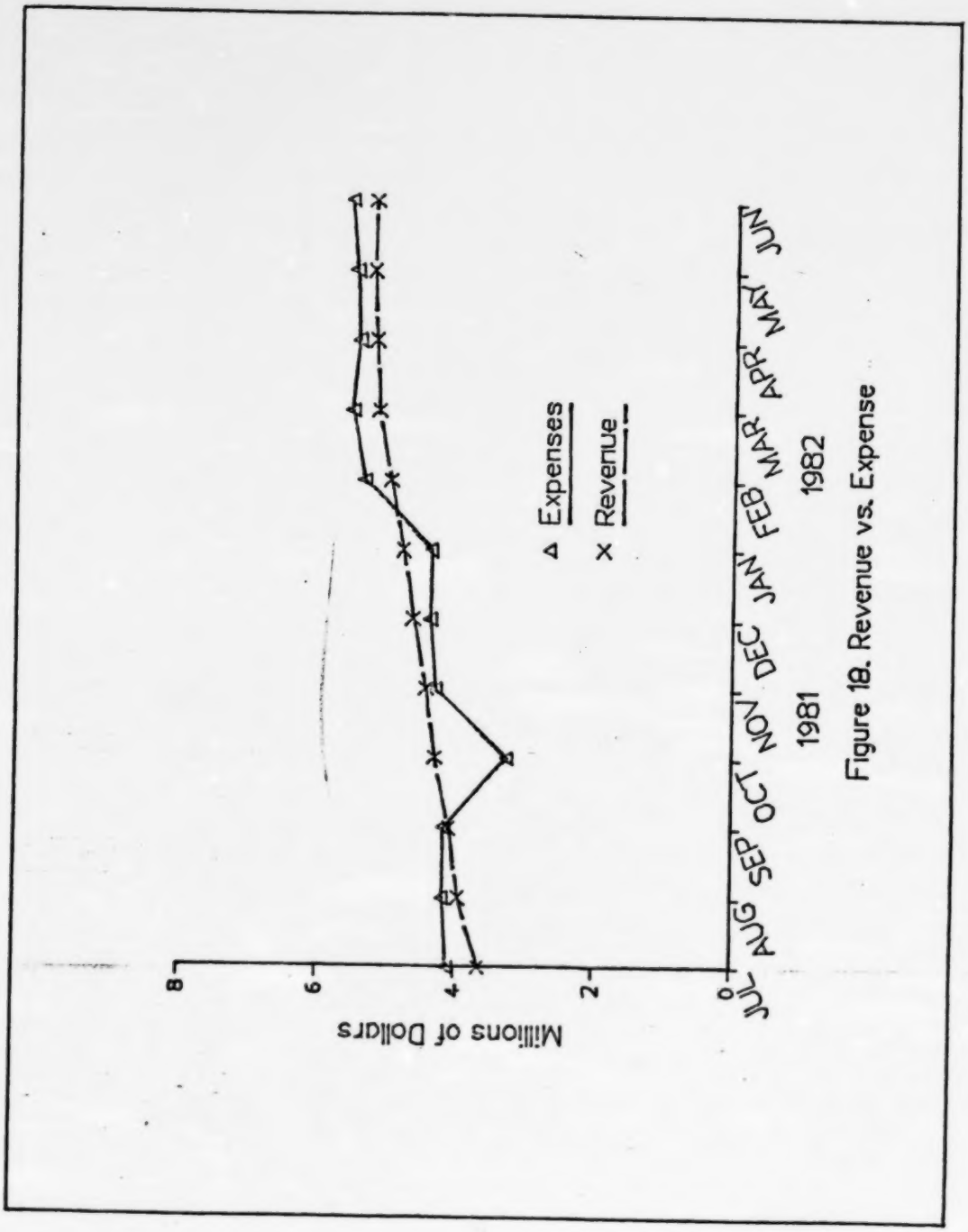


Figure 18. Revenue vs. Expense

This system can be used to monitor costs and make critical management decisions. Special users can be targeted, and costs allocated against these users. In addition, developing the system will encourage the establishment of common cost categories among the various wastewater utilities so that productivity, efficiency, and performance measurements can be compared for cost-effective management decisions. Wastewater utilities can be operated on a self-sustained basis, and will probably be required to be so operated in the future.

ACKNOWLEDGEMENTS

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